Electronic Supplementary Information

Ultrasensitive detection of thiram based on surface-enhanced Raman scattering via Au@Ag@Ag core/shell/shell bimetallic nanorods

Yuqiu Wang[a], Shuchang Liu[a], Yongjun Hu*[a,b,c], Cuicui Fu*[d], Weiqiang Chen*[a,b,c]

[a] MOE Key Laboratory of Laser Life Science & Institute of Laser Life Science, College of Biophotonics, South China Normal University, Guangzhou 510631, PR China.

[b] Guangdong Provincial Key Laboratory of Laser Life Science, College of Biophotonics, South China Normal University, Guangzhou, 510631, China.

[c] Guangzhou Key Laboratory of Spectral Analysis and Functional Probes, College of Biophotonics, South China Normal University, Guangzhou 510631, China.

[d] Chongqing Key Laboratory of Inorganic Special Functional Materials, College of Chemistry and Chemical Engineering, Yangtze Normal University, Chongqing, 408100, China.

*Email: yjhu@scnu.edu.cn (Prof. Yongjun Hu); chran16@163.com (Prof. Cuicui Fu); achenweiqiang@m.scnu.edu.cn(Prof. Weiqiang Chen)

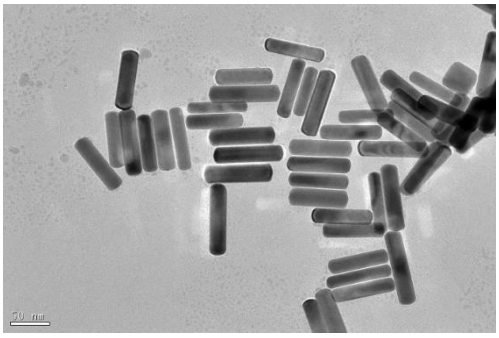

Fig. S1 TEM images of Au NRs.

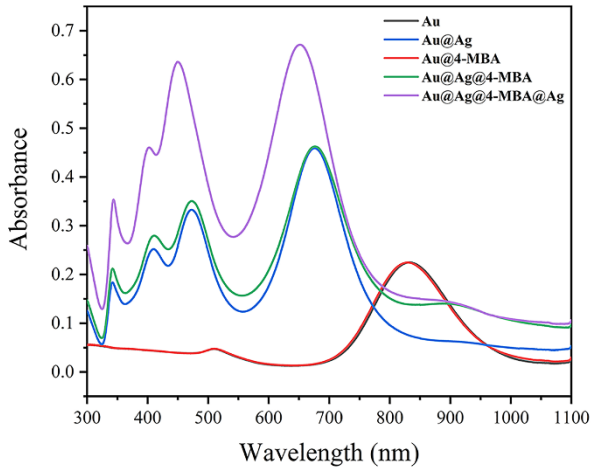

Fig. S2 UV–visible spectra of Au NRs, Au@4-MBA NRs, Au@Ag NRs, Au@Ag@4-MBA NRs and Au@Ag@4-MBA@Ag NRs.

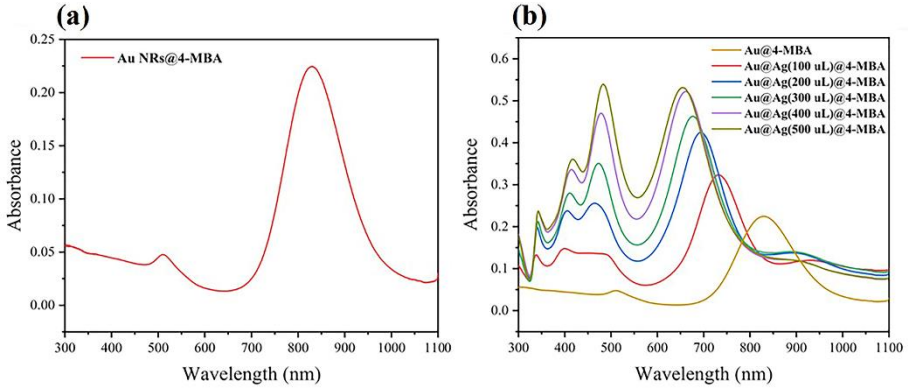

Fig. S3 UV-vis absorption spectra of the core-only Au@4-MBA NRs (a); The UV-vis absorption spectra of the Au@Ag@4-MBA NRs synthesized with different volumes of $AgNO_3$ (10 mM) and fixed 4-MBA concentration of 8×10^{-7} M (b).

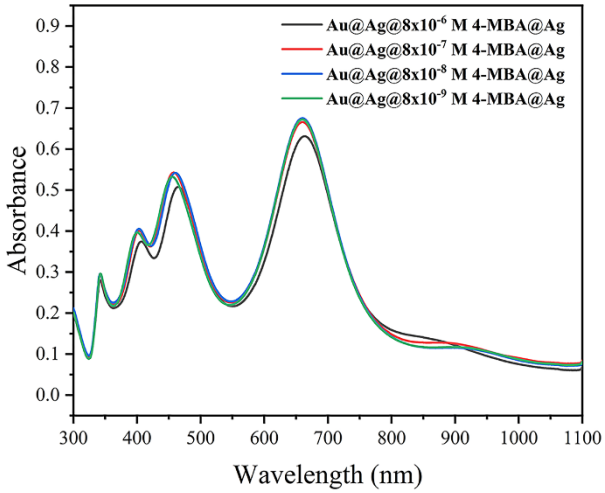

Fig. S4 UV-vis absorption spectra of Au@Ag@4-MBA@Ag NRs synthesized using different concentrations of 4-MBA.

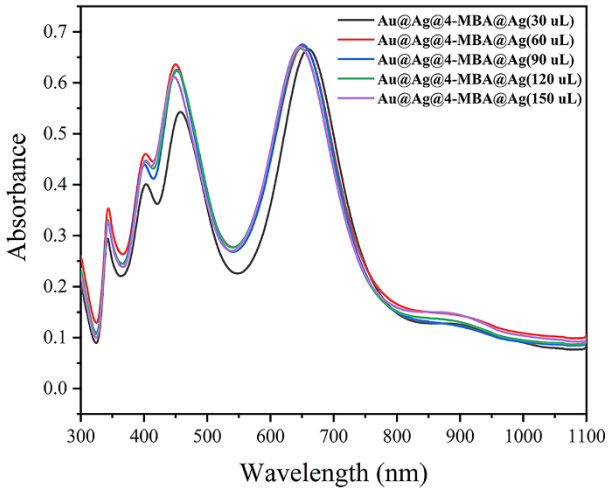

Fig. S5 UV-vis absorption spectra of Au@Ag@4-MBA@Ag NRs with different second-Ag-layer thicknesses obtained by addition of different $AgNO_3$ volume.

Table S1 Table of the SERS bands associated with thiram[1].

Raman shift (cm^{-1})	Assignment
423 (vw)	υ(C=S)
548 (m)	υ(S-S)
917 (m)	υ(CH_3N), υ(C=S)
1130 (m)	ρ(CH_3), υ(CN)
1368 (vs)	δ s(CH_3), υ(CH_3)
1441 (vw)	δ as(CH_3)
1495 (m)	ρ(CH_3), υ(CN)

Note: s = strong, w = weak, m = medium, sh = shoulder, v = very, υ = stretching, δ = deformation, ρ = rocking.

References

1 M. Chen, W. Luo, Q. Liu, N. Hao, Y. Zhu, M. Liu, L. Wang, H. Yang and X. Chen, Anal. Chem. 2018, 90, 13647–13654.